Properties of Controlled-Release-Water-Retention Fertilizer Coated with Carbonaceous-*g*-Poly (acrylic acid-co-acrylamide) Superabsorbent Polymer

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***Abstract*—Fertilizer and water are very important in determining the production of agriculture nowadays. Apart of that, the excessive use of fertilizer in plantation somehow could leads to environmental pollution. The present study reported a preparation of controlled release water retention (CRWR) fertilizer coated with superabsorbent polymer (SAPs). The purpose of coating the fertilizer using SAPs is to enhance the utilization of fertilizer and reduce the environmental pollution. In this study, the synthesis of carbonaceous-SAPs was carried out via solution polymerization technique by using monomers of poly(acrylic acid) (AA) and acrylamide (AM), cross linker of methylene bisacrylamide (MBA) and initiator of ammonium peroxodisulfate (APS) that partially neutralized with sodium hydroxide (NaOH). The fertilizer granule then was coated with carbonaceous-SAPs which later known as CRWR fertilizer. The morphology and the bonding formation of the CRWR fertilizer were investigated by using Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectrophotometer (FTIR), respectively. Moreover, the water absorbency and water retention in soil were conducted in order to investigate the efficiency of carbonaceous-SAPs on the properties of CRWR fertilizer. Based on the results, it was found that the CRWR fertilizer coated with carbonaceous-SAPs had higher water absorbency and water retention ability than the CRWR fertilizer without carbonaceous-SAPs. The addition of the carbonaceous filler in the formulation of SAP increase the water uptake compared to unfilled-SAP. Moreover, types of soil also play an important factor in water retention properties. CRWR fertilizer in organic soil results in higher water retention ability compared in top soil.**

***Index Terms*—Carbonaceous particles, superabsorbent polymer, coating material, water retention.**

I. Introduction

The agriculture sector plays an important role in economic development, uplifting rural incomes and help in ensuring national food security [1]. Internationally agriculture has become the centre of cutting-edge research and development (R&D) as the drive to feed and cope with global population. In general, the main factors that affect the growth of plants and their quality include the amount of water and fertilizers that can be absorbed by plants. Besides maintaining the water resources, the used of fertilizer is also crucial for plant growth as it function as one of the nutrients sources for plant in order to achieve maximum efficiency and highest quality product. In order to increase the production, excessive fertilizers are normally were practiced in agricultural activities in order to fulfill the required nutrients as it will subsequently affect the quality of yield [2]. The practice of excessive used of fertilizer however is not efficient as not all nutrients from these fertilizers can be absorbed by the plant as it will be washed or leached out during rain [3]. According to Al-Zahrani [4], only 30% of the fertilizers are effectively used and utilized by plants while the balance is lost to environment. Besides of the increasing of productive cost, this practice also causes a negative impact especially on the environment as some fertilizers does contains heavy metals such as cadmium, chromium and high concentrations of radionuclides [2].

As reported by Guo et al., (2005), the loss of fertilizer in agricultural activities can cause large economic losses and environmental pollution. One of the solutions to this problem is by applying controlled release fertilizer. The use of slow release fertilizer is considered as a new trend to save fertilizer consumption and to minimize environmental pollution [6]. Practically, there are a few factors that controlled the release of the fertilizers include the soil's temperature, microbial activity, soil moisture, pH and organic matter. The present study proposed a preparation method of controlled release water retention (CRWR) fertilizer coated with carbonaceous-superabsorbent polymer material. CRWR fertilizer is known as a basic type of controlled release fertilizer (CRFs) that implement superabsorbent polymer (SAPs) as a coating material which designed to control the nutrients release from fertilizer and enhance the efficiency of nutrients use for plant growth [7]. Meanwhile, according to Liu & Guo [8], SAPs can be defined as a long chains polymer which are slightly cross-linked that has ability to swell and maintain bulky of water and aqueous solutions after absorb. The presence of hydrophilic groups such as carboxylic, carboxamide, hydroxyl, amine and amide in the polymer backbone are the main cause of the hydrophilic nature of SAPs [9]. Due to their ionic nature and interconnected structure, they absorb large quantities of water via hydrogen bonds, increasing the entropy of the network to make the SAPs swell dramatically in size [10]. In agriculture, superabsorbent polymers can be used to preserve the water in the soil and carriers for nutrients [11]. Higher water-holding capacity and nutrient retention in soils is important as it can increase the soil's aeration and microbial activity, reduce the

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